

OSHA-NDLON

TRAIN-THE-TRAINER #5: SCAFFOLDS, EXCAVATIONS AND TRENCHES

This material was produced under grant number SH-22234-11-60-F-6 from the Occupational Safety and Health Administration, U.S. Department of Labor. It does not necessarily reflect the views or policies of the U.S. Department of Labor, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

This workshop is designed to give participants an introduction to the safe measures that should be taken when working with scaffolds and trenches. It is not intended to replace a proper skills training in the construction and use of scaffolds. Additionally, when working in trenches, a competent person should test the dirt and assess any potential hazards associated with the area that is to be excavated.

This training aims at:

- Introducing participants to the types of scaffolds and materials they are made of.
- Giving participants the basic information they should know to use scaffolds safely.
- Giving participants the basic information needed to be safe when working in trenches.
- Having participants identify potential hazards in scaffolds and trenches.
- Create a sense of compañerismo and self care so that workers can watch out for their own safety and that of their co-workers.

Activity 1: Introduction to Scaffolds

Share the following information with participants:

Scaffolds can be used in construction, alteration, routine maintenance and renovation. Using scaffolds can be safer than leaning over edges, stretching overhead and working from ladders. When work must be done and there is no other safe alternative to reaching elevated work locations, scaffolds provide safe access, so long as they are erected and maintained properly.

However, workers should be aware that there are hazards associated with scaffolds. The most common accidents that occur when using scaffolds are workers falling, objects falling and hurting workers, scaffolds collapsing and electric shock.

There are many factors to scaffolding accidents that we must consider when working with or around them: failures at attachment points, parts failure, inadequate fall protection, improper construction or work rules, and changing environmental conditions (high winds, temperature extremes or the presence of toxic gases). Additionally, overloading of scaffolding is a frequent cause of major scaffold failure.

Activity 2: Let's get to know scaffolds!

Scaffolds are temporary elevated platforms (supported or suspended) used to support people and materials in the construction or repair of buildings and other large structures. It is usually a modular system of metal pipes or tubes, although it can be from other materials.

Basic parts of scaffolds:

Base- scaffolds must have base plates resting on a firm foundation to make sure they won't move or shift.

End frames- they serve as supporting structures that transfer the load. Frames are made up in various widths and heights and for various load capacities.

Cross braces- they are used in pairs to join frames together and provide stability.

Coupling Pins- they are inserted in top of the frame legs to stack the frames.

Lock Pin- placed through the frame leg and coupling pin to prevent the frames separating.

Planks/Boards- Forms the working or loading platform for persons and materials. Scaffold platforms must be fully and properly planked. The planks must fully cover the platform to create a safe working surface. Gaps between the planks and the uprights must not be greater than 1 inch wide.

Guardrails- they are used when working on scaffolding at heights of 6 feet or more above a lower level. The guardrails will provide a physical barrier to prevent you from falling. The guardrail system must be installed along all open sides and ends of the platforms.

Toe boards- they are installed on all the outer edges of the platform where there is a possibility of materials or tools falling off the platform. The top of the toe board must be at least 4 in. above the platform.

Stairs- they are incorporated into a frame structure to provide access to the scaffold.

Types of Scaffolds:

Two general terms are used for the types of scaffolds used in most work situations.

Support scaffolds are scaffolds supported by poles, legs, posts, frames and uprights on base plates or mudsills or other adequate firm foundation.

Suspended scaffolds are attached to a roof and securely anchored or stabilized with counter weights. The scaffold is then suspended above the ground and held securely by proper procedures.

Adjustable scaffolding can be raised and lowered with pulleys or mechanical systems.

Correct Use of Scaffolds:

Activity 3: Constructing a scaffold

With the use of a model scaffold we will recreate the way in which a scaffold is constructed. We will videotape this section of the training so that participants can take a copy home and show it to workers as many times as necessary. NDLO will purchase a model scaffold that will be available to our partners upon request.

Activity 4: Think before you Climb!

Tell participants that before using a scaffold, they must know what hazards to look for. Employers must make sure that the scaffold to be used has been checked by the competent person after it was constructed. Weight limits, height, secure footings, ties to the building, proper guard rails, safe distance from power lines and safe walking foundation are some of the main points that are checked on support scaffolds. If you notice any irregularity with the way a scaffold is constructed, do NOT climb on it!

Also, remember that these inspections must be done before each day or shift begins. Scaffolding also must be inspected if it is moved, if a new crew comes aboard or if weather/environmental issues might jeopardize worker safety occurs.

Your employer must provide training that includes:

- The hazards of type of scaffold being used;
- Maximum intended load and capacity;
- Recognizing and reporting defects;
- Fall hazards;
- Electrical hazards including overhead lines;
- Falling object hazards;
- Other hazards that may be encountered.

Also, your employer must provide proper Personal Protective Equipment. Fall protection is the most important personal equipment for those who work on scaffolding.

Note: Workers and onlookers should not walk under or near scaffolding. Hard hats should always be worn by those on and around scaffolds.

Activity 5: Recognizing the hazards in Scaffolding

Electric Hazards:



Because they may be built in proximity to overhead power lines, and because they are often made of metal, scaffolds can put workers at risk of electrocution. This risk can be removed through proper clearance and maintenance. Check to see if power lines near scaffolds are de-energized or that the scaffolds should be at least 10 feet away plus 0.4 inches further per 1 kilovolt over 50 kilovolts from energized power lines. Also, make sure that tools and materials are at least 10 feet away from energized power lines.

Scaffold Collapse:



Scaffolds and scaffold components must be capable of supporting, without failure, their own weight and at least 4 times their maximum intended load. Verify that the scaffold is the correct type for the loads, materials, employees, and weather conditions. Check footings to see if they are level, sound, rigid, and capable of supporting the loaded scaffold. Check metal components for bends, cracks, holes, rust, welding splatter, pits, broken welds, and non-compatible parts.



Check legs, posts, frames, and uprights to see if they are on base plates and mudsills. Poor housekeeping should also be considered as a hazard when working on or near scaffolds.

Falls:



Fall protection consists of either personal fall-arrest systems or guardrail systems, and must be provided on any scaffold 6 feet or more above a lower level. Also, check for safe access, do not use the cross braces as a ladder for access or exit.

Falling Objects:



Nothing that could cause a slip, trip or fall (i.e. tools, scrap material, chemicals, snow, ice, etc.) is allowed to accumulate on the platform. There are two kinds of falling object hazards associated with scaffolds. One concerns the employees on the scaffold itself, and the other concerns employees who may work in or enter the area

below the scaffold. Each employee on a scaffold must be protected from falling hand tools, debris, and other small objects, by wearing Hardhats. Also, Toeboards, screens, or guardrail systems should be adopted.

Activity 6: Name the hazard!

Show participants pictures of several hazards associated with scaffolding. Ask them to identify what's wrong with the scaffold.



Hazard: Fall from scaffold; collapsing scaffold.

Standard violated: 1926.451: Employees working on improperly constructed scaffolding system.

Corrective Action: Erect proper scaffold system.



Hazard: Fall from scaffold.

Standard violated: Platform not fully planked (1926.451(b)) and employee climbing cross braces (1926.451(e)).

Corrective Action: Provide safe access. Fully plank scaffold platform.



Hazard: Fall from scaffold.

Standard violated: 1926.451(c): Scaffold not plumb and braced to prevent swaying and displacement. Cross bracing missing.

Corrective Action: Plumb scaffold. Install cross braces.



Hazard: Fall from scaffold

Standard Violated: 1926.451(c)(2): Supported scaffold poles, legs, posts, frames, and uprights did not bear on base plates and mud sills or adequate firm foundation.

Corrective Action: Properly install base plates and mud sills on scaffolding.



Hazard: Electrocution

Standard: 1926.451(f)(6): This scaffold was within minimum distance of 10 feet of the overhead power lines with 300 volts to 50KV.

Corrective Action: The scaffold shall not be erected, dismantled, used or altered near energized power lines.



Hazard: Fall from scaffold and steep roof. Struck by falling materials.

Standard violated: 1926.451(g), 1926.451(b), 1926.100(a), 1926.451(h), 1926.501(b)(11): Fall protection not provided. Scaffold not fully planked. Hard hats and falling object protection not provided.

Corrective Action: Install guardrails on scaffold. Fully plank scaffold. Provide hard hats and falling object protection and steep roof fall protection.

Images and information acquired from:

<http://www.msabc.net/safety%20programs/falls%20in%20construction/index.htm>

Activity 7: Introduction to Excavations and Trenches

The use of excavation is common in constructions. Excavations can vary widely in shape and size depending on the work situation.

What is the difference between an excavation and a trench?

An excavation is a man-made cut, cavity, trench or depression in the earth's surface formed by earth removal. This can include excavations for anything from cellars to highways.



A trench is defined as a narrow underground excavation that is deeper than it is wide, and no wider than 15 feet (4.5 meters).



Dangers of trenching and excavation operations

Trenching and excavation work presents serious hazards to all workers involved. Cave-ins pose the greatest risk and are much more likely than other excavation-related accidents to result in worker fatalities. A cave-in can trap you within seconds and kill you within minutes. Two cubic yards of soil weight about 6,000 pounds, if the soil covers you completely, you can suffocate within minutes.

Other potential hazards include falls, falling loads, hazardous atmospheres, lack of oxygen, toxic fumes, explosive gases, buried power lines and incidents involving mobile equipment.

What hazards should be considered when assessing an excavation?

A safety checklist may prove helpful when you consider specific site conditions. Here are some things to consider before digging:

- Remove any debris near the excavation site that could create a hazard. The side of the excavation must be trimmed or scaled to remove any loose materials or rocks.
- How workers will get in and out of the excavation. Safe access must be provided in the immediate area where workers are employed in trenches over 4 feet or more in depth so as to require no more than 25 feet of lateral travel by employees. Ladders must extend from the bottom of the excavation

- to at least 3 feet above ground.
- How to protect workers from falling into the excavation.
- Have a plan to respond to emergencies.
- Know what's below. Call 811 to locate utility services in the area such as electrical, gas, steam, water and sewer.
- Possibility of water in the excavation.
- Stability of soil at the excavation site.
- Stability of structures near the excavation site. Trees, utility poles, rocks or similar objects in the vicinity must be secured or removed.
- Shock and vibration from machinery, traffic or blasting.
- Weather conditions.
- Traffic- traffic control and high visibility clothing must be used.

You can determine these and other conditions through jobsite studies, observations, test borings for soil type or conditions, and consultations with local officials and utility companies. This information will help you determine the amount, kind and cost of safety equipment you will need to perform the work in the safest manner possible.

How can you prevent cave-ins?

OSHA requires that all excavations in which employees could potentially be exposed to cave-ins be protected by:

- Sloping or benching the sides of the excavation,
- Supporting the sides of the excavation, or
- Placing a shield between the side of the excavation and the work area.

Designing a protective system can be complex because you must consider many factors, such as soil classification, depth of cut, water content of soil, changes due to weather and climate, or other operations in the vicinity. You are free to choose the most practical design approach for any particular circumstance. Once you have selected an approach, however, the system must meet the performance criteria in the standard.

Protection from Cave-ins

The basic methods of protection from cave-ins are sloping, benching, shoring and shielding. The method to be used depends on factors such as soil type and water content, excavation depth and width, the nature of the work, and nearby activities that could increase the risk of a cave-in. The competent person has the responsibility for considering these factors and for determining the appropriate protective system.

Sloping and Benching

Sloping and benching provide protection by removing material from the face of an excavation at an angle to its floor; in general, the flatter the angle the greater the protection. Benches are cuts in the slope that give it a stair-step appearance. There are two types of benches: simple and multiple.

Rain, vibration and pressure from heavy equipment can make soil unstable and increase the risk of a cave-in. Sloped or benched excavations that show signs of cracks, bulges, or clumps of soil that fall away from the faces are dangerous and must be inspected by a competent person. You must immediately get out of an excavation and stay away until the competent person determines it is safe to enter.

Shoring and Shielding

Shoring and shielding can prevent cave-ins in excavations with or without sloped or benched faces. The safest way to install and remove them is from outside the excavation.

Shores are vertical or horizontal supports that prevent the faces from an excavation from collapsing. Vertical shores are called uprights. They are easy to install, relatively inexpensive and often used in stable soil or in shallow excavations that have parallel faces. Vertical shores must be sized for the excavation's dimensions and soil type.

Horizontal shores are called walers. They are often used when unstable soil makes sloping or benching impractical and when sheeting is necessary to prevent soil from sliding into the excavation.

Shields provide workers a safe work area by protecting them from collapsing soil. They don't prevent cave-ins, but "shields" workers if a face does collapse.

Types of Soil:

Some soils are more stable than others. The type of soil at an excavation site is one of the factors that determine the chance of a cave-in. There are three basic soil types:

Type A – Defined as cohesive soil with an unconfined compressive strength of 1.5 tons per square foot or greater. As a practical matter, Type A soil is also rare because previously disturbed soils, or soils subject to vibration from construction equipment, traffic, railways, etc., are disqualified as being "Type A." Clay is an example.

Type B – Defined as moderately cohesive soil. Not as good as Type A, but not as bad as Type C soil. Crushed rocks, silt and soils that contain an equal mixture of sand and silt are examples.

Type C – Defined as the least cohesive soils, having an unconfined compressive strength less than .5 tons per square foot. This includes wet, granular, or loose soils. The best way to remember Type C is to think of the “C” standing for crummy. It is the least stable type of material. The “Competent Person” [CP] is required to perform at least one visual and one manual test of the soil.

Soil has other qualities that affect its stability. These include granularity, saturation, cohesiveness, and unconfined compressive strength.

Here are some ways to test the soil type:

Visual Test – To make a visual test, the “Competent Person” observes soil as it is being excavated. Soil that remains in large clumps is cohesive, and is probably Type A or Type B soil (depending upon other factors). Soil that flows out of an excavator bucket is granular, loose, or wet, and is probably Type C. The CP should also check the sides of the excavation for layered systems, water, utilities, and signs of previously disturbed soils. The CP must also be vigilant for sources of vibration.

Manual Tests – There are a number of different manual tests included in the OSHA Standard.

The Dry Strength, Thread, or Ribbon Tests can be used to determine if a soil is cohesive or granular.

The Thumb Penetration Test relies heavily upon the experience of the person performing the test. In the Thumb Penetration Test, the “Competent Person” gathers a handful of freshly excavated soil and presses his/her thumb into the material.

Type A soils require a great amount of effort to indent the soil. Type B soils can be indented with moderate pressure. Type C soils require little or no effort.

Pocket Penetrometers and Shearvanes can be used to determine the approximate unconfined compressive strength of soils.

Examples of manual tests:

Plasticity test. Shape a sample of moist soil into a ball and try to roll it into threads about 1/8-inch in diameter. Cohesive soil will roll into 1/8-inch threads without crumbling.



Dry strength test. Hold a dry soil sample in your hand. If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder, it's granular. If the soil breaks into clumps that are hard to break into smaller clumps, it may be clay combined with gravel, sand, or silt.



Thumb penetration test. This test roughly estimates the unconfined compressive strength of a sample. Press your thumb into the soil sample. If the sample resists hard pressure it may be type A soil. If it's easy to penetrate, the sample may be type C.



There is one method of Soil Classification that the CP can employ to avoid all these tests. He/She can assume the “worse case” scenario and classify all soil as Type C. The trench or excavation can then be sloped, shored, or shielded accordingly. In fact, many contractors and utilities take the position that every soil they work in is Type C. That helps to simplify the entire trenching and excavation safety process immensely.

Note: Before starting an excavation, a competent person must conduct visual and manual soil tests. These tests are a critical part of determining the type of protective system that will be used. A “competent person” is described as “one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.”

Additional Information:

The American Public Works Association (APWA) Uniform Color Codes
Utility color codes are used for identifying existing underground utilities in construction areas with the intent of protecting them from damage during excavation.

The APWA Uniform Color Codes for temporary marking of underground utilities are listed below:

White	PROPOSED EXCAVATION
Fluorescent Pink	TEMPORARY SURVEY MARKINGS
Red	ELECTRIC POWER LINES, CABLES, CONDUIT AND LIGHTING CABLES
Yellow	GAS, OIL, STEAM, PETROLEUM OR GASEOUS MATERIALS
Orange	COMMUNICATION, ALARM OR SIGNAL LINES, CABLES OR CONDUIT
Blue	POTABLE WATER
Purple	RECLAIMED WATER, IRRIGATION AND SLURRY LINES
Green	SEWERS AND DRAIN LINES